FLORA OF THIRUVANANTHAPURAM KERALA

M. MOHANAN and A.N. HENRY

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FOREWORD

Botanical Survey of India has been actively engaged in the preparation of detailed accounts on the flora of India in different series. Flora of Thiruvananthapuram, Kerala is a contribution towards series - 3, District Floras.

Thiruvananthapuram, the southern-most district of Kerala, lying adjacent to Kanyakumari is physiographically divisible into coastal zone, having an extensive system of backwaters (Kayals), midland zone mostly under cultivation; and mountainous zone consisting of hills of elevations varying between 1000 and 1869 m. Owing to its significant geographic position in the southern end of W. Ghats, varied climate and altitude, the flora of this district has become very rich and diverse. Agastyarkudam (Agastiar Peak), the highest point in the mountainous tract is a unique natural unit possessing a number of endemics, rare and threatened plants and potential resources of economic plants. Since Tropical rain forest is entering a period of rapid decline as a world natural resource, Agastyamalai must be regarded as a prime example of this ecosystem in Southern India, requiring urgent conservational practices. In addition to providing an authentic inventory of the plants of this district, the speedy establishment of a Biosphere Reserve in and around Agastyamalai region is also proposed.

I am sure, the flora of Thiruvananthapuram, Kerala by M. Mohanan and A. N. Henry should not only serve the purpose of identification, but also should be useful for students, teachers, ecologists, agriculturalists, foresters and persons concerned with the utilization and conservation of plant resources. The information will also be useful for phytogeographers, environmental biologists and those revising the flora of Kerala.

Botanical Survey of India
Calcutta

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Director

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INTRODUCTION

Plants and plant products have been the primary base upon which the modern civilization has been built. The study of plants appears to have originated from a purely utilitarian point of view Man depended directly or indirectly on plants for his welfare. In fact, plants have been a source of extensive supply of materials to man for the last 2000 years. Admittedly, the primitive man must have had an economic interest in the plants around him particularly in those that were of direct use to him. Medicinal plants no doubt attracted him the most and as a result, various systems of folk medicine developed all over the world independently.

The development of modern chemistry and technology gave a new phase to pharmaceutical industry wherein chemical composition of plants was analysed and chemical synthesis in several cases effected As a consequence, most of the mystic remedies of the ancient 'herbalists' have given way to modern, more efficacious drugs. In addition, plants yield a wide variety of raw materials for the modern industry.

Despite the enormous efforts made in the past towards the economic utilization of the natural potentialities of our rich forests, there still remains a lot of work to be done for an accurate appraisal of our plant wealth. Floristic investigations have a vital role to play in the development of plant-based industries in a developing country like India. For the standardisation of plant products and for effective utilization of economic plants, it is imperative that the correct identity and nomenclature of the plants concerned are determined. Therefore a reliable floristic inventory is a pre-requisite for a just assessment of the plant wealth of a given area, more so in a tropical country like India wherein the population pressure continues to lead to the over-exploitation and consequent disappearance of the precious forests. Such an inventory may also help the conservationists to take adequate protective measures against rare and threatened plant communities / species in time lest they get wiped out from the face of earth.

The forests of Kerala are considered to be an inestimable reservoir of timbers of diverse kinds. That the wood from these forests was used in building ships centuries ago might corraborate this fact. In addition, Kerala forests harboured a wide variety of economically important plants. Kerala has been a well-known important centre of world trade in spices especially pepper, cardamom and ginger. A better understanding of the floristic composition of Kerala may certainly open more avenues for such trades and accrue foreign exchange earnings in their wake. Much work has been done in the past by foreigners, but the information gathered is inadequate and a relatively larger area of Kerala State remains still underexplored.

Thiruvananthapuram is one of the botanically less explored districts in Kerala and no concerted effort appears to have been made in the past, to completely explore the district, possibly due to its difficult terrain and inaccessibility of certain areas. The present work was, therefore undertaken with a view to providing an authentic inventory and other adequate information pertaining to the flora of this relatively underexplored district. It is further hoped that this work will greatly help in the preparation of the State Flora of Kerala.

Although the primary objective of this work is purely botanical to critically study all the angiospermic plants and provide the correct identity and nomenclature of the same, it is ardently desired that this work would certainly prove useful to the students and teachers of Botany as well as to the practical plant users of this region, whose main source of reference so far are the out-dated floras like Hooker *et. al.* (1872-1897), and Gamble and Fischer (1915-1936 Repr. ed. 1957).

PAST BOTANICAL EXPLORATIONS

The first reference bout the plants of this district can be found In Rheede's *Hortus Indicus Malabaricus* (1678-1703). Barber, Beddome, Bourdillon, Jacob, Lawson, Narayanaswami, Rama Rao, Venkoba Rao and Wight are the pioneers who botanised this district while it was part of the erstwhile Travancore State, but no comprehensive account on the flora is available. Wight's *Icones Plantarum Indiae Orientalis* (1838–1853), and *Illustrations to Indian Botany* (1840-1850) include many plants from this region. The collections of Cullen, a resident of Thiruvananthapuram formed the basis for the publication of Drury (1864).

Bourdillon (1893) presented a report on the Forest Trees of Travancore which formed the basis of his later monumental work on the *Forest Trees of Travancore* (1908). Nagam Ayya (1906) and Velu Pillai (1940) gave a delightful description of the vegetation of the erstwhile Travancore State. Lawson visited Ponmudi, Merchiston and Thiruvananthapuram in 1893-94 and recorded his visits in *Notes of a tour in Travancore etc.* (1894). In 1914, Rama Rao, the then Conservator of Forests of Travancore compiled, "A Preliminary List- of 3335 plants with the help of Curator Venkoba Rao who was a devo ted plant collector of this area.

Thomas (1962) explored the hills and swamps of Veli with spe cial reference to ecological factors. He has also studied the aquatic vegetation of Thiruvananthapuram (1976), and the changing pattern of ecosystem in Kerala (1981). Rao and Sastri (1971, 1972, 1974a 1974b) have given an account of the floristics and ecology of Veli.

Contributions have been made by Raizada and Chatterjee (1963) Maheswari (1964), Vasudevan Nair (1966) Nayar (1966, 1969). and, Ravi (1970), based on sporadic collections. Joseph and Chandrasekh-aran 1973, 1974, 1978, 1982) have undertaken 3 exploration tours to Boneccord, Neyyar Wildlife Sanctuary and the western slopes of Aga styarkudum. Observations on the pteridophytic flora have been made by Nair and Ghosh (1974, 1976, 1977a, 1977b). More recently Abra ham and Vatsala (1981) have collected orchids from Ponmudi and Boneccord. Mamen and Mamen (1974) and Pempahishey (1976) conducted one expedition each to Agastyar peak and collected *Paphiopedilum druryi.*

Ponmudi and Veli were frequently visited by Students from vari-ous colleges. A perusal of the herbaria in Coimbatore (MH), Calcutta (CAL) and the University College, Thiruvananthapuram shows tha thet collections of specimens from this district are meagre compared to other districts of the Peninsula.

PRESENT WORK

Field explorations were planned in such a way that collections and observations could be made every month in all seasons. During the field work, special care was taken to note down data on pheno-logy, habit and habitat, frequency of distribution and association with other plants and any other characteristics that are likely to disa-pper in a herbarium specimen. For such of those plants that were

observed in vegetative condition in a trip the localities were noted down so as to facilitate their easy relocation in the subsequent trips. Every attempt was made to collect the plants in flower and fruit and to find out the occurrence of every plant throughout the district so as to get a clear picture of its range of distribution and relative abundance in the district.

The specimens collected were identified provisionally in fresh condition using the descriptions and keys of Bourdillon (1908) and Gamble & Fischer (1915-1936, repr. ed. 1957). They were then poisoned in a saturated solution of mercuric chloride in rectified spirit. Thereafter they were pressed and herbarium sheets prepared according to conventional methods. The flowers of delicate specimens were preserved in 4% formaldehyde. Live specimens of many rare and interesting plants were brought and introduced into the garden at Coimbatore and Yercaud and observations made on their phenology and life cycles.

Each plant was critically studied and identified using Gamble and Fischer (1957) and Hooker ital. (1872-1897). The identities were later confirmed by comparing the specimens with authentic or type specimens in MH, and CAL, and referring to the recent monographs and revisions. All specimens collected are deposited in MH.

The nomenclature of each species has been brought up-to-date as per the rules given in the *International Code of Botanical Nomenclature* (1988). The correct identity and taxonomic status of each taxon were also fixed by using the 'type method'

PLAN OF THE FLORA

The families are arranged according to Gamble and Fischer's *Flora of the Presidency of Madras* (1915-1936, repr. ed. 1957) which is about the same as Hooker *et al. Flora of British India* (1872-1897). But the circumscription of a number of families are restricted following Hutchinson (1959) and Ariy Shaw (Willis, A Dictionary of Flowering Plants and Ferns. 8th ed. 1973).

Dichotomous keys are provided to families, genera, species and infraspecific categories. These are artificial and based mainly on the exomorphic characters wherever possible. The keys are intended for the identification of plants from the area of study only. The genera under a family and species of a genus are arranged alphabetically.

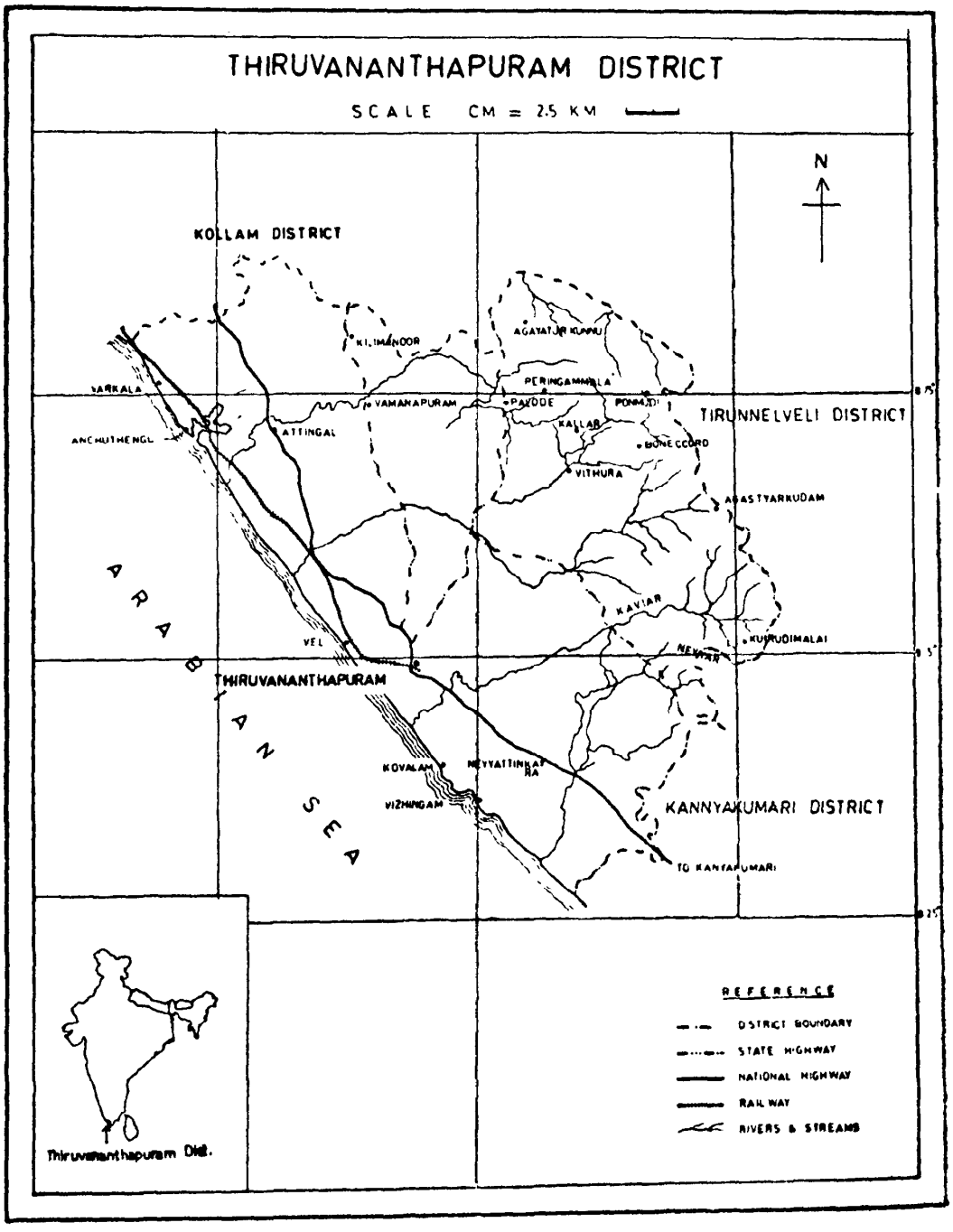
The treatment of each species includes the original citation of the correct name followed by relevant synonyms if any, thereby facilitating a reference to various Indian Floras and Publications. The abbreviations of reference given in the text are as given in Botanico-Periodicum-Huntianum (1968). However, a few unusual abbreviations have been adopted forthose references commonly made in the work and these are as follows :

Bor	-	Bor, N L. Grasses of Burma, Ceylon, India and Pakistan (excluding Bambusaceae) 1960.
Bourd.		Bourdillon, T. F. Forest Trees of Travancore 1908.
Dunn	-	Dunn, S. T. In Gamble, Flora of the Presidency of Madras. Vo. 1 : 1 - 132. 1957 (repr. ed.).
FBI		Hooker et al. Flora of British India VII Vol. 1872-1892.
Gamble		Gamble, J. S. - Flora of the Presidency of Madras Vol. 1 : 133-408 & Vol. 2. 1957 (repr. ed.)
Rao	-	Rama Rao, M Flowering plants of Travancore. 1914.

The citation of nomenclature is followed by a short description of the plants. Concise descriptions of the species reflecting only the distinguishing characters are given. The descriptions are based on present collections and earlier collections (if any from the area) available in the Herbarium of MH, CAL and University College, Thiruvananthapuram.

The frequency of distribution and a short note on the ecologica preference of the plant are given after the description, based on original observations in the field. In most of the cases, localities and forest types from where the collections were made are also furnished along with notes on ecology. Economic uses and ethnobotanical information of the plants are given, wherever original information could be gathered. This is followed by local names if any and flowering and fruiting periods.

Any additional information about plants such as variation on floral or vegetative characters, critical notes on the identity and nomenclature and other relevant data on distribution are given in 'notes' in the last part of enumeration of each species.


THIRUVANANTHAPURAM DISTRICT
SCALE CM = 2.5 KM
N
KOLLAM DISTRICT
KILIMANOOR
AGAYATTUR KUPPU
PERINGAMMALA
VARKALA
VAMANAPURAM
PAYODE
PONMUDI
TIRUNNELVELI DISTRICT
ANCHUTHENGU
ATTINGAL
KALLAR
BONACCORD
VITHURA
AGASTYARKUDAM
ARABIAN SEA
KAVIAR
KURUDIMALAI
VEL
NEYYAR
THIRUVANANTHAPURAM
KOVALAM
NEYYATTINKARA
VIZHINGAM
KANNYAKUMARI DISTRICT
TO KANYAKUMARI
REFERENCE
DISTRICT BOUNDARY
STATE HIGHWAY
NATIONAL HIGHWAY
RAIL WAY
RIVERS & STREAMS
Thiruvananthapuram Dist.

THE AREA OF STUDY

1. *Origin of the Name Thiruvananthapuram :*

The name Thiruvananthapuram is believed to be originated from 'Thiru-ananthapuram' which is presumed to be after 'Anantha' the many headed serpant supporting Sri Padmanabha, the deity of Sri Padmanabha Swami Temple. The erstwhile 'Trivandrum' is an abbreviated form of Thiruvananthapuram. It was also called 'Syanandrum' (Sreedhara Menon, 1962; Velu Pillai, 1940).

2. *Location and boundary :*

This district came into being on November 1, 1956 with a total area of 2191 92 sq. km. This one of the smallest district in the southern-most part of the state lies between north latitude 8°17' 50" and 8°53' 42" and east longitudes 76° 40' 24" and 70° 17' 00". It is bounded on the east by Tirunelveli District and south by Kanyakumari District of Tamil Nadu, north by Kollam District and west by the Arabian sea.

3. *Topography :*

On a physiographic basis, the district is divided into 3 zone: coastal, midland and mountainous (Sreedhara Menon, 1962)

a) *The Coastal Zone :* The coastal zone comprises flat undulating lands except the hills at Veli and Varkala. One of the many natural advantages of this district is the presence of an extensive system of backwaters and canals for navigation. The main backwaters ('Kayals') are Veli, Vellayani, Kadinangulam and Anjengo.

b) *Midland Zone :* This zone consists of the undulating land lying between the coastal and mountainous zones and is mostly under cultivation.

c) *Mountainous Zone :* It consists of hills which form the southern-most part of the Western Ghats. The main ghats stretch along the eastern border with elevations varying between 1000 and 1869 m presenting a picturesque of "a panorama of inexpressible grandeur". (Nagam Aiya, 1906). Several streams originating from the slopes of higher ridges form numerous water falls and emerge as gentle rivers in the bottom of valleys The top and higher slopes of the ghats are very steep and rocky and in many places inaccessible. Such places

are usually barren. The lower slopes of the ghats on the other hand are covered with a dense vegetation. The highest point in the tract is the Agastyarkudum with an altitude of 1869 m. Other important peaks are Aduppukal mottai, Chemungi mottai, Klamala and Ponmudi. This system of hills forms a barrier between Tamil Nadu and Kerala. After the closure of the 'Aryanad Pass' the only entrance now is a trunk road, from Tirunelveli to Trivandrum although there are foot-paths in the forests from Kannikatti to Boneccord.

Main river system : The following are the main rivers.

i) *Attungal Vamanapuram river* (66 km). Originating from the peak of Chemungi mottai (1706) passes through Nellanad, Vamanapuram, Attungal, Chirayankil and empties itself into the Anchuthengu estuary.

ii) *Karamana* (65.6 km). Rises on Chemungi mottai (1706 m) and joins the Arabian Sea at Punthura near Kovalam.

iii) *Neyyar* (66 km.) takes its origin in the slopes of Agastyarkudum (1869) and discharges itself into the Arabian Sea near Paravur lake where a lagoon is formed. There are several small rivers which join the main ones forming a river system.

4. *Geology, Rock and Soil :*

The area is geologically divisible into 3 minor belts, viz. a coastal belt of recent deposits, a narrow belt of pleistocene or late tertiary (Varkala beds) and a narrow belt of laterite and a high mountain belt of crystalline rocks.

The cystalline rocks consist of leptynites and charnokites, hornblende and gneisses, schists and granulites.

Varkala beds ('Warkalai beds') can be clearly seen in cliffs edging the seashore. It consists of a succession of sand stones and sandy clay. A grey clay with patches of lignified wood and carbonaceous clay with pieces of resin and marcasite are common.

The laterite extending up to 160 m below the surface occurs extensively between Neyyatinkara and Thiruvananthapuram. Sandy coast consists of quartz sand, ilmenite and monazite.

Building stones (*'Vetukal'*) are charnockites and leptynites and occur in the interior parts of the district. Gemstones ('quartz') and banded agate jaspar (*'Vaiduryam'*) are reported from Nedumangad and Chirayankil taluks. Glass sand, graphite, ileminite, lignite, mica etc. also occur in this district.

Soil is almost wholly loam of varying depth in different places. In the coastal line soil is usually deficient in potash. Clayey soil is reported from Varkala and Kazhakottam. On the top of hills and elevated grounds which are subjected to heavy run off, laterite grave and broken pieces of rocks at different stages of disintegration are found in a large proportion.

Climate :

The climate of this area is moderately humid. The variation in temperature is a little. The maximum mean daily temperature in the plains during the hottest month (March) is 32.4°C. Mean daily minimum temperature in the coldest month (January) is 22.2°C. (Table 1). On the hills, it is 25°C and 16°C respectively varying slightly with altitude.

Rainfall : The district receives both southwest and northeast monsoons. Southwest monsoon commences from June and continues up to September. After a pause, northeast monsoon sets in. The average annual rainfall is 1874 mm (Based on 6 years average from 1977-1982 Source : Meteorological Centre, Thiruvananthapuram). There are 98 rainy days on an average. The rainfall varies depending upon the topography (Table 2). Rainfall generally decreases from the northwest to the southeast due to its position in the southern end of the peninsula.

Humidity : The atmosphere is humid throughout the year. From December to May, the humidity is slightly less (Table-1).

Wind : The average annual wind velocity in Thiruvananthapuram is 7-9 km/hr. The highest speed is reported from May to September (11-2 km/hr.) and the lowest in December (4-8 km/hr.) (Kareem, 1978). The velocity of wind is higher in subtropical montane forests of Ponmudi, Chemungi and Agastyarkudum.

Special weather phenomena indicating changes are uncommon in this district except, perhaps, the occurrence of thunders in March to June and October to November. The Total number of days with thunder in a year is estimated to be 70 (Kareem, 1978).

TOPOGRAPHIC DISTRIBUTION OF RAINFALL IN MM*

Months	Nedumangad	Thiruvananthapuram	Neyyattinkara
Jan.	27.2	22.9	31.7
Feb.	22.1	20.8	17.8
Mar.	65.5	38.6	40.4
Apr.	172.5	105.7	103.9
May	227.8	207.8	185.7
June	408.7	356.4	298.5
July	227.6	223.0	188.7
Aug.	190.5	145.5	119.4
Sept.	181.4	137.9	126.7
Oct.	342.4	273.3	260.1
Nov.	246.6	205.5	235.2
Dec.	78.5	74.7	74.4
Annual	2240.4	1812.1	1682.5

* Based on available data up to 1970.

STATISTICAL ANALYSIS OF THE FLORA

The systematic botanical exploration for a period of over five years in this district has resulted in the collection of 3100 field numbers of 9300 specimens. These specimens belong to a total of 1270 species in 710 genera spreading to 163 families. (Pteridophytes are not included).

The distribution of the families, genera and species with respect to dicots. monocots and gymnosperms are as follows :

	Families	Genera	Species
Dicots	135	528	939
Monocots	25	179	328
Gymnosperms	3	3	3
Total	163	710	1270

Except the Gramineae Cyperaceae and Orchidaceae, the mono cots in general are poorly represented. Over 50% of the monocots belong to the above three families. Similarly among the dicots, the the Leguminosae, Rubiaceae and Euphorbiaceae constitute about one fourth of the total number of species.

A comparison of the 10 largest families in order of their species content with that of India (Hooker, 1904), Madras Presidency (Fischer, 1935). the Western Peninsula (Hooker, 1904) and the Western Ghats (Subramanyam and Nayar, 1974) is given in Table-4.

The Leguminosae and Gramineae take the first two positions as in the case of the Madras Presidency, but in the Western Ghats and Western Peninsula the order is the reverse-the Gramineae supersede the Leguminosae. Orchidaceae which from the largest family in India attain only a third position in the Thiruvananthapuram District, whereas in the Madras Presidency and Western Peninsula including Western Ghats their position is sixth and fourth respectively.

Asteraceae, one of the largest families in the World come only to at sixth position here. Rubiaceae, fourth in the Indian flora and third in the Madras Presidency have come to the fourth position compared to their seventh position in the Western Peninsula and Western Ghats. Euphorbiaceae, the fifth largest family in the Indian flora and Madras Presidency, remain un-altered in their position in this district also whereas the position of Acanthaceae is eighth in this district. In India, Acanthaceae attain the six position and fourth in the Western Peninsula and Western Ghats.

The Cyperaceae, the eight largest family in India and inthe Madras Presidency attain the seventh position in this district whereas inthe

COMPARISON OF THE FIRST TEN LARGEST FAMILIES

India (Hooker 1904)	Madras Presidency (Fischer 1935)	Western Peninsula (Hooker 1904)	Western Ghats (Subramanyam & Nayar 1974)	Thiruvananthapuram District (Present study)
ORCHIDACEAE	LEGUMINOSAE	GRAMINEAE	GRAMINEAE	LEGUMINOSAE
LEGUMINOSAE	GRAMINEAE	LEGUMINOSAE	LEGUMINOSAE	GRAMINEAE
GRAMINEAE	RUBIACEAE	ACANTHACEAE	ACANTHACEAE	ORCHIDACEAE
RUBIACEAE	ACANTHACEAE	ORCHIDACEAE	ORCHIDACEAE	RUBIACEAE
EUPHORBIACEAE	EUPHORBIACEAE	CYPERACEAE	COMPOSITAE	EUPHORBIACEAE
ACANTHACEAE	ORCHIDACEAE	EUPHORBIACEAE	EUPHORBIACEAE	COMPOSITAE
COMPOSITAE	COMPOSITAE	RUBIACEAE	RUBIACEAE	CYPERACEAE
CYPERACEAE	CYPERACEAE	COMPOSITAE	ASCLEPIADACEAE	ACANTHACEAE
LABIATAE	LABIATAE	LABIATAE	GERANIACEAE	LABIATAE
URTICACEAE	ASCLEPIADACEAE	ASCLEPIADACEAE	LABIATAE	SCROPHULARIACEAE

Western Peninsula they are the fifth largest family and in the Western Ghats they find no place among the ten largest families.

The position of Lamiaceae in India, Madras Presidency and in the Western Paninsula is unaltered in this district also, while Geraniaceae take the eighth position in the Western Ghats. Urticaceae, Asclepiadaceae and Geraniaceae do not figure in the 10 largest families in this District.

The following familes are represented in this district by only one species. They are Mangoliaceae, Nelumbonaceae, Nymphaeaceae, Cabombaceae, Brassicaceae, Xanthophyllaceae, Ancistrocladaceae, Linaceae, Ochnaceae, Dichapetalaceae, Opiliaceae, Erythropalaceae, Leeaceae, Sabiaceae, Chrysobalanaceae, Sonneratiaceae, Aizoaceae, Cornaceae, Alangiaceae, Hydrophyllaceae, Avicenniaceae, Phytolaccaceae, Chloranthaceae, Cassythaceae, Thymelaeaceae, Elaeagnaceae, Balanophoraceae, Daphniphyllaceae, Cycadaceae, Podocarpaceae, Gnetaceae, Burmanniaceae, Costaceae, Marantaceae, Haemodoraceae, Smilacaceae, Flagellariaceae, Alismataceae and Aponogetonaceae.

GENERAL PATTERN OF VEGETATION

1. *Coastal region* This region consists of strand and estuarine vegetation. Strand vegetation is of 2 types, viz. strand sand and strand rock. Strand rock is not of common occurrence. a. *Strand sand* : The coastal line is bordered by coconut plantations. Sand-binders like *Gisekia pharnaceoides, Heliotropium marifolium, Indigofera spicta, Ipomoea pes-caprae, Justicia tranquebariensis, Pedalium murex, Polycarpaea corymbosa, Polycarpon prostratum, Rothia indica Zoysia matrella* are common. The common shrubs in the mixed bushy zone are *Capparis brevispina, Erythroxylum, monogynum Gmelina asiatica, Hugonia mystax* etc. The inner hilly woodland region is characterised by the presence of *Coffea travancorensis, Hopea ponga, Morinda citrifolia, M. pubescens, Manilkara hexandra, Uvaria zeylanica* and *Wrightia arborea*. *Cassytha filiformis* is a common parasite in this region.

b. *Estuarine vegetation* : Pro-estuaries like Tidal mangroves, Prohaline and Euhaline are found along the coast.

i) *Tidal mangroves :* This type is fouud in Anjengu, Kadinamkulam, Nadayara, Veli and Vellayani. Along the margins of the lakes is seen abundant growth of *Acanthus ilicifolius* and *Acrostichum*

aureum forming extensive belts. *Cissus vitiginea, Derris trifoliata, Flagellaria indica, Gloriosa superba,* and *Parsonsia alboflavescens* are the common climbers. The common trees are *Avicennia officinalis, Barringtonia racemosa, Brugiera gymnorrhiza, Sonneratia caseolaris,* etc.

ii. *Prohaline* : Salt-tolerant fresh water plants like *Ceratopteris siliquosa, Corchorus aestuans, Crinum asiaticum, Hygrophila erecta, Salvinia molesta, Sphenoclea zeylanica* and *Striga asiatica* are found in this type.

iii. *Euhaline* : This type is characterised by highly salt-tolerant plants like *Acanthus ilicifolius, Acrostichum aureum* and *Pandanus fascicularis.*

2. Midland region : Most of the area in this region is unde cultivation of crop plants like coconut. arecanut, tapioca, paddy etc. The common weeds in the cultivated lands are *Acalypha clicita, Acrocephalus hispidus, Ageratum conyzoides, Alloteropsis cimicnia, Biophytum sensitivum, Borreria articularis, B. latifolia, B. ocymoides, Catharanthus pusillus, Centella asiatica, Cleome vis, cosa, Cyperus kyllingia, C. rotundus, Emilia sonchifolia, Dactyloctenium aegyptiacum, Pepercomia pelluida, Pousolzia zeylanica, Syn edrella nodiflora, Tridax procumbens,* etc.

The stagnant pools and canals in the midland harbour a rich aquatic vegetation. The common plants are *Blyxa octandra Cyperus geminiflora, Eichhornia crassipes, Hydrilla verticillat Hygrorhiza aristata, Lindernia crustacea, Nelumbo nucifera, Monochoria vagrnalis, Nymphae nouchali Nymphoides indica, Paspalum distichum, Sacciolepis interrupta* etc.

3. Mountainous region: Seven major type to of forests (Champion and Seth, 1964) are met with in this region. A clear-cut demarcation is not possible as they merge with each other.

a). *West coast tropical evergreen forests*: This type of forest occurs at higher slopes of ridges along eastern border especially in the upper sources of the rivers Kallar, Karamana and Neyyar under the high peaks of Chemungi, Ponmudi and Agastyarkudam. This is characterised by a variety of species in several tiers or storeys, the upper consisting of lofty trees with 40 m or more tall. The bases of many trees are often buttressed. Trees are sparingly branched with smooth boles and glossy, feathery leaves. Lianas

are characteristic. A large number of epiphytes are found on the tree trunks. These forests experience heavy rainfall and high humidity. Drought spell is short.

The dominant trees in the first storey are *Ailanthus triphysa Antiaris toxicaria, Artocarpus hirsuts, Bombax ceiba, Callophyllum apetalum, Caryota urens, Cullenia exarillata, Diospyros bourdillonii Elaeocarpus tuberculatus Hopea parviflora, Lophopetalum wightianum, Mesua nagassarium, Palaquium ellipticum, poeciloneuron indicum, Toona ciliata, Vateria indica, Vitex altissima* etc.

The second storey conists of medium-sized trees like *Actinodaphne bourdillonii, Aporosa lindleyana, Aglaia eleagnoidea,* var. *roxburghiana, Carallia brachiata, Canarium strictum, Cinnamomum macrocarpum, C. verum, Euodia lunu-ankenda, Ficus arnottiana Garcinia morella, Dimocarpus longan, Gordonia obtusa, Polyalthia coffeoides, Symplocos cochinchinensis* and *Xanthophyllum flavescens*.

The Third storey is formed of plants like *Arenga wightii, Atalantia wightii, Canthium angustifolium, Glycosmis cymosa, G. mauritiana, Ixora malabarica, Isonandra lanceolata, Leea indica, Pinanga dicksonii, Psychotria curviflora, P. congesta, P. nodiflora, Pavetta calophylla, Tarenna canarica, T. asiatica* etc.

The ground flora consists of *Acranthera grandiflora, Asplenium indicum, Angiopteris evecta, Begonia malabarica, Commelina ensifolia, Cyathea gigantea, Dictyospermum montanum, Elatostemma lineolatum, Malaxis rheedii, Mollineria trichocarpa, Neanotis monospema, Neurocalyx calycinus, Ophiorrhiza brunonis, O. eriantha, O. mungos, O. prostrata, Peliosanthes teta* ssp. *humils, Phyllanthus gardnerianus, Schizoloma ensifolium, Sonerila rheedii* etc.

Along the margins of rivers are seen large formations of *Pandanus thwaitesii.* Epiphytes like *Eria reticosa, Dendrobium heterocarpum, Oberonia brunoniana, O. verticillate, O. wightiana, Pholidota imbricate, Polystachya flavescens, Pyrrosia adnascens, Peperomia portulacoides* and parasites like *Dendrophthoe falcata Helixanthera intermedia* and *Taxillus tomentosus* etc. are common.

The common climbers include *Adenia hondala, Argyreia hirsuta, Aristolochia indica, Calamus pseudotenuis, C. huegelianus, Erythropalum populifolium, Dioscorea oppositifolia, D. pentaphylla, Myxopyrum serratulum, Pothos armatus, P. scandens, Sarcostigma kleinii* and *Gnetum ula.*

b). *Southern hill top tropical evergreen forests :* This type is found in valleys surrounding high ranges especially in Ponmudi. Chemungi and Agastyarkudum and is confined to altitudes ranging from 1000 to 1200 m. The trees are shorter with fuller and rounded crowns. This is a transition stage from tropical to subtropical forests.

The upper storey consists of *Cullenia exarillata, Elaeocarpus serratus, E. tuberculatus, Ficus arnottiana, Glochidion ellipticum Gluta travancorica, Holigarna arnottiana, Mesua nagassarium, Persea macrantha, Semecarpus anacardium, Syzygium zeylanicum, Toona ciliata* etc.

The medium-sized trees in the second storey are the yonger form of the upper storey along with *Alstonia venenata, Debregeasia ceylanica, Memecylon angustifolium* etc. The lower storey is formed by shrubs and herbs like *Asystasia dalzelliana, Diotacanthus grandis, Nilgirianthus heyneanus, N. foliosus, N. warrensis, Pavetta oblanceolata, phaulopsis dorsiflora, Plectranthus wightii, Pogostemon paniculatus, P. pubescens, P. travancoricus, Psychotria flavida, Rauvolfia densiflora, Rostellularia quinquengularis, Sarcandra chloranthoides, Tarenna alpestris* and *Wendlandia bicuspidata* The common climbing shrubs are *Dioscorea wallichii, Eleagnus conferta, Jasminum conferta, Jasminum cordifolium, Millettia rubiginosa* and *Smilax zeylanica.*

c) *Southern subtropical hill forests (Subtropical montane forests):*

This type is confined to altitudes ranging between 1200 and 1600 m at Ponmudi, Chemungi and Agstyarkudum. Though it is comparable to the tropical evergreen type, the vegetation is not very luxuriant. The low stature of trees of these types are mainly due to high velocity of wind and less favourable conditions of soil (Adriel, 1964). A major part of this type is already cleared for tea plantations and the rest is fast giving rise to secondary types due to biotic interference.

The characteristic trees in the first story are *Brysophyllum tetrandrum, Callicarpa tomentosa, chionanthus courtallensis Eurya*

Euphorbia santapaui, Ficus arnottiana, Elaeocarpus tuberculatus, Eurya nitida, Ficus arnottiana, Glochidion arboreum, Gordonia obtusa, Heritiera papilio, Maesa indica, Neolitsea cassea and *Persea macrantha*. On the rocky slopes are found large populations of *Bentinckia condapanna*.

The second storey is formed of *Canthium dicoccum, Memecylon angustifolium, Scleropyrum pentandrum, Syzygium arnottianum, S. gardneri* etc. The lower storey cosists of *Nilgirianthus foliosus, N. heyneanus, Pogostemon purpurascens* etc. A large number of ferns are also found.

The major portion of the slopes is exposed and covered by grasses like *Arundinella ciliata, Chrysopogon zeylanicum, Cyrtococcum patens, Eragrostis tenuifolia, Ischaemum indicum, Oplismenus burmannii, Panicum notatum, Themeda cymbaria and Tripogon bromoides*. Amidst the grasses are found *Blumea barbata, Brachycorythis splendida, Crotalaria scabra, Gynura pseudo-china, Peristylus goodyeroides, Pecteilis gigantea, Phoenix humilis* var. *pedunculata, Phyllocephalum scabridum, Rostellularia japonica* and *Spilanthes paniculata*.

d) *West coast semievergreen forests :* This type is common adjoining evergreen forests and along the sides of rivers and is confined to areas wherever alluvial deposits are rich. The forests in its best form is met with in places like Kallar, Peppara, Kaviar and Suryakanthi. A mixture of both the evergreen and deciduous trees is found The characteristic trees in the first storey are *Alstonia scholaris, Artocarpus heterophyllus, Buchanania lanceolata, Baccaurea courtallensis, Calophyllum apetalum, C. inophyllum, Catunaregam rugulosum, Carallia brachiata, Dimocarpus longan, Grewia tiliifolia, Holigarna arnottiana, Hopea parviflora, Hydnocarpus alpina, H. pentandra, Humboldtia vahliana, Ixora brachiata, I. nigricans, Knema attenuata, Lagerstroemia speciosa, Madhuca neriifolia, Mastixia arborea* subsp. *meziana, Nothopegia travancorica, Syzygium gardneri, Tamilnadia uliginosa, Terminalia paniculata* and *Vitex pinnata*.

The lower storey consists of *Agrostistachys meeboldii, Aporosa lindleyana, Arenga wightii, Clausena heptaphylla, Clerodendrum viscosum, Cinnamomum verum, Flemingia strobilifera, F. semialata, Homonoia riparia, Uvaria narum* etc. Large areas on the ground are covered by *Costus speciosus* and *Globba ophioglossa*. The common climbers are *Adenia hondala, Butea parviflora, Calamus*

huegelianus, C. pseudotenuis, C. travancorica, Calycopteris floribunda, Strychnos minor etc. Large formations of *Bambusa arundinacea* are common along the margins of rivers.

e) *Southern secondary moist mixed deciduous forests :* This type occurs at lower elevations. The composition is mixed with scattered trees like *Bridelia retusa, B. scandens, Buchanania lanzan, Careya arborea, Cycas circinalis, Dalbergia latifolia, Dillenia pentagyna, Lannea coromandelica, Macaranga peltata, Mastixia arborea* subsp. *meziana, Olea dioica, Pterocarpus marsupium, Tectona grandis, Terminalia bellirica, T. chebula, T. paniculata* etc. *Phyllanthus emblica* is common with a dense growth of grasses like *Cyrtococcum oxyphyllum, Imperata cylindrica* var. *minor, Pennisetum polystachyon* and *Pseudanthistiria umbellata* where soil is shallow and poor.

f) *Wet bamboo brakes :* This type occurs only in places where there is a break in the canopy such as on sides of streams at higher slopes or gaps created by felling. As the reeds are very aggressive and capable of withstanding partial shade, they colonise very quickly into large populations. It has been observed that wherever forest fire occurs, the area would be soon covered by the reeds. Large portions of the slopes of Chemungi and Agastyarkudum are entirely covered with reeds. The inhabiting species are *Ochlandra ebracteata, O. scriptoria, O. wightii* and *O. travancorica.*

g) *Myristica swamps* : Partially cleared myristica swamp forests are located in the Kottur Reserve. This is a characteristic edaphic formation found in the bottom of valleys which is subjected to inundation throughout the year. The floor of the swamp is often covered by looped knee-roots of *Myristica* species. The common elements are *Myristica dactyloides, M. fatua* var. *magnifica, M. malabarica, Knema attenuata, Hydrocarpus alpina* and *Lophopetalum wightianum.* Large population of *Lagenandra toxicaria* is also noticed covering the ground. On the edges of the forests are found *Hopea parviflora* and *Humboldtia vahliana* with a dense undergrowth of *Nilgirianthus* spp.

In addition to the above seven types, a characteristic vegetation is found along the major rivers like Neyyar, Karamana and Vamanapuram which is classified (Champion and Seth, 1968) as *Southern tropical moist deciduous riverine forests.* The main elements found in this type are *Agrostistachys meeboldii, Ixora nigri-*

cans, Lagerstroemia microcarpa, L. speciosa, Homonoia riparia, Lophopetalum wightianum, Hydnocarpus pentandra, Vateria indica and *Vitex altissima*. Occurrence of this type is so limited for a special mention.

The ancient walls (east and west fort and old buildings) form a specialized habitat for certain plants. Varshney (1968) has pointed out the importance of wall flora. The following are some of the common plants found on the ancient walls: *Acalypha indica, Achyranthes aspera, Ageratum conyzoides, Amaranthus spinosus, A. viridis, Apluda mutica, Boerhavia diffusa, Cassia tora, Chloris barbata, Cyperus compressus, Eclipta prostrata, Eleusine indica, Euphorbia hirta, E. thymifolia, Evolvulus alsinoides, E. nummularius, Ficus exasperata, F. religiosa, Lantana camara* var. *aculeata, Ocimum basilicum, Oxalis corniculata, Paspalum distichum, Phyllanthus fraternus, P. reticulata, Physalis minima, Pilea microphylla, Portulaca oleracea, Ravina humilis, Solanum nigrum, Tridax procumbens, Vernonia cinerea, Vicoa indica*.

The occurrence of some trypical Sri Lankan elements in the forests of this district is a striking peculiarity of the flora. They are *Andrographis zeylanica, Chrysoglossum maculatum, Eria muscicola, Exacum walkeri, Garcinia echinocarpa, Catunaregam gardneri, Phaius luridus, Rubus micropetalus* etc.

Agastyarkudum and its adjoining regions in the Tirunelveli District of Tamil Nadu form an isolated area and a considerable number of endemics are reported from this belt. The species endemic to Thiruvananthapuram and Tirunelveli are *Acranthera grandiflora, Bentinckia condapanna, Cinnamomum gracile, Didymocarpus ovalifolia, D. repens, Dimorphocalyx beddomei, Diotacanthus grandis, Hedyotis albo-nervia, H. travancorica, H purpurascens, Impatiens auriculata, I. travancorica Lasianthus cinereus, Popowia beddomeana, Thottea barberi, Vernonia bourdillonii* and *V. ramaswamii*.

BIOTIC INTERFERENCE ON THE FLORA

Ever since civilization, man has been a serious biotic factor affecting the vegetation. Modern man heavily depended on the forests for his welfare and in this process, unjudiciously destroyed larger part of the forests. The increase in population and advance in

civilization have resulted in a greater demand of forest land for habitations, agriculture etc. and a considerable area of our dense forests has been cleared or much disturbed. In Thiruvananthapuram district, about 18440.47 hectares of virgin wet tropical evergreen forests were recorded (Adriel, 1964). But a large portion of these forests have been already cleared for plantations and habitation.

1. *Plantations*

The subtropical hill forests (Subtropical montane) at Ponmudi and Merchiston have been partially cleared for tea plantations. In Boneccord, tea plantations have been raised by clearing forests at lower elevations (between 600 and 1100 m). With the influx of population in these estates, the adjacent areas covered by dense forests are also in danger of destruction.

Moist deciduous forests at lower elevations have also been disturbed considerably and plantations of rubber, teak, cashew and jungle woods like Jack *(Artocarpus hererophyllus)* 'Angili, (*Artocarpus hirsutus*) and soft wood like *Pithecellobjum monadelphum* established.

2. *Tribal settlements*

The tribals in this district are called *'Kanikkar'* There are about 75 tribal settlements in places like Pallode (35), Kottur (21) and Klamala (19).

The forest lands adjacent to these settlements are being subjected to shifting cultivation and have either given rise to deciduous forests with large populations of grasses and *Pteridium aquilinum* or have been invaded by reeds, eventually making them reed brakes (wet bamboo brakes).

3. *Construction of Dams*

Construction of dams for irrigation and water supply has also caused considerable damage to the vegetation. There are two major irrigation projects and two minor projects for water supply.

Neyyar Dam

This dam was constructed on Neyyar river at valleys of Akastyarkudum by the Kerala Public Works Department for irrigating Neyyatinkara and Vilavankode taluks of Kerala and Tamil Nadu respectively. The reservoir has an area of 1433 hectares with several islands. Trees from 810 hectares were removed and *Eucalyptus* plantation started from 1962 onwards. Around 607.5 hectares on the upper part of the reservoir is still covered by dense forests

Neyyar Wildlife Sanctuary

The areas surrounding the Neyyar reservoir and abjacent areas were declared as Wildlife Sanctuary by the Government of Kerala in 1958 (*vide* Kerala Govt. Order D/0 M.S. 871/58 dated 6-8-1958). The total area is about 129.5 sq. km. including Klamala and Kottur Reserve Forests. The reservoir has 13 islands viz. Marakkunnu, Aruvippuram, Vazhamoola, Uzhamalakkunnu, Kottur etc. The tribal settlements in the sanctuary are Puriamala, Thenmala, Kunnathumala, Kompaikani and Ayyavilakam. The common wildlife met with in this area are the spotted deer, sambar, elephant, liontailed monkey and the Nilgiri tahr. The eastern boundary of the sanctuary is covered with dense evergreen forests.

Peppara Dam

This dam is constructed at Peppara in Karamana river by the Kerara Public Health Engineering Department to supply water to Thiruvananthapuram city as there is scarcity of water supply to the city. The dam was inagurated on Oct. 1983. The catchment area of the dam was estimated as 86 sq. km. which enjoys an average rainfall of 482 cm. The full reservoir is estimated to be 110.5 m with a water-spread area of 582.5 hectares from river level. The submergible area is covered by semievergreen and moist deciduous forests. It is interesting to note that after the construction of this dam, a large number of wild animals and birds migrated to this region. Madhavan Pillai (The Hindu Dec 25, 1983) noted that herds of elephants and sambar have already moved towards the dam and the reservoir attracted several water birds including darters and cormorants.

Aruvikkara Dam :

This is a small dam on Karamana river at Aruvikkara, a few kilometers from Nedumangad.

Vamanapuram Irrigation Project (Valayanki Dam)

Work on this project was initiated recently. The dam will be constructed on Vamanapuram river at Vallayanki below Kallar Valley to irrigate Nedumangad, Thiruvananthapuram and part of Chirayankil Taluks of this District. With the completion of this project, a large portion of dense evergreen and semievergreen forests in Kallar valley will be submerged.

4. *Grazing*

Another serious biotic factor affecting the vegetation is grazing by cattle. It has been observed that over-grazing on the grassy slopes of subtropical hill forests of Ponmudi has caused considerable damage to the vegetation cover. These areas are now being invaded by alien shrubs and herbs like *Crassocephalum crepioides*, *Duranta repens*, *Lantana camara* var. *aculeata*, *etc.*

5. *Wildlife*

Wild animals cause comparatively negligible damage to the vegetation, the main threat being from the elephants which feed on selected forest plants. Other common animals met with are the spotted deer, sambar, liontailed monkey and the Nilgiri tahr.

6. *Impact of Industrialization*

The main industries in this district are centred at Veli which include the English Indian Clay, Travancore Titanium Products, Trancos Ltd. and T.K. Chemicals. The strand and estuarine vegetation of Veli is being threatened by the effluents released from these industries, The actual Veli hills from where Barber and others made extensive collections of plants is now completely cleared for the construction of Vikram Sarabhai Space Centre. Very little attention has been paid to the real pollution problem in industrial section of Veli and even common plants of these araa are facing danger of destruction. Suresh Elamon (1982) states that the Veli swamp had been a heaven for bird watchers and botanists. The first 'death-knell' of this mini sanctuary was sounded when the area was acquired by the Vikram Sarabhai Space Centre. With the construction of the road bisecting the swamp, the vestiges of the mangrove thickets were also lost.

Prospects of Conservation

Based on the above observations in the field, the following suggestions are made to protect atleast the existing forests and to conserve the vanishing flora of this region.

1. *Establishment of a Biosphere Reserve in Agastyarkudum and its Environs*

The Man and Biosphere Programme sponsored by the United Nations has undertaken an important initiative to set up a net work of Biosphere Reserve with a view to providing an assured future for mankind (IUCN, 1979). In India 14 sites for biosphere reserves have been identified and 7 have been set up including the Nilgiris in the South. Agastyarkudum and its environs form another potential site which would best fulfil the objectives of a biophere reserve and a suggestion has already been made by Henry *et al.* (1984).

The criteria for the selection of a site for biosphere reserve is laid down in the MAB report of UNESCO (1974) and it is generally agreed that the main criterion for the choice of conservation of an area is the "value jugement of a viable unit" (Crisp, 1980). It implies that the area must be of a minimum size to ensure effective conservation. These criteria in relation to Agastyarkudum are discussed below:

Ecosystem diversity

Agastyurkudum and its vicinity form a natural unit with a maximum diversity of ecosystem due to various climatic and geographic features.

Naturalness

The area possesses natural forests which probably evolved in course of millions of years and very little disturbances was done to these forests. Several wild relatives of cultivars are also found here.

Effectiveness as a viable unit

Agastyarkudum is a unique isolated tract in the southernmost

part of the Western Ghats which can be easily managed as there are Wildlife sanctuaries surrounding the area.

Presence of endangered species

A number of endemic, rare and threatened species of plants are reported from this region (Henry *et al.* 1979; Mohanan *et al.* 1980a & 1980b).

Agastyarkudum and its immediate environs from the "core zone" with little human interference. The semievergreen forests and moist mixed deciduous forests below this will constitute the "buffer zone" for mauipulative research and the wildlife sanctuaries and the reserve forests outside, with several tribal settlements will best serve as a "stable cultural zone" with scope for ethnobotanical studies. In view of the above facts it is hoped that speedy steps will be taken to establish the above biosphere.

2. There is a proposal by the Tourist Department (Kerala State Tourism Development Corporation) to construct a bridlepath from Kottur to Agastyarkudum. It is suggested that the proposal should be dropped.

3. *Checking the introduction of alien plants in Ponmudi*

In the recent past, there has been a rapid development in the beautification of Ponmudi Tourist Centre and a large number of alien plants are introduced in this area which will adversely affect the native flora in due course. It is suggested that indigenous plants be selected to replace the alies in the beautification programme. Further, several forest trails are being constructed for the tourists from Ponmudi downwards, through the dense forests which will in due course disturb the area. These forest trails may be closed.

OBSERVATIONS

The present work relates to an intensive systematic study on the Flora of Thiruvananthapuram District for a period of over five years. This botanically rich area was relatively unexplored but for some pioneering work done in the past by the froest officials. However, no comprehensive account on the flora of the

whole District has been prepared so far. Through well-planned and intensive field work, a lot of firsthand information on the flora of this area has been gathered. A large portion of the slopes of Agastyarkudum, Kallar and Chemungi remained unexplored due to to the inaccessibility of the difficult terrain. In the present study every attempt was made to concentrate on such areas and gather information on endemic, rare and threatened plants. Further, the present work is the first of its kind to completely explore the submergible areas of Peppara and Vamanapuram River Projects. These studies have resulted in the discovery of 2 new species viz. *Cinnamomum chemungianum* (Lauraceae) and *Syzygium parameswaranii* (Myrtaceae) and 2 new varieties viz. *Eria muscicola* (Lindl.) Lindl. var. *ponmudiana* (Orchidaceae) and *Exacum courtallense* Arn. var. *boneccordiana* (Gentianaceae).

Eragrostis cumingii Steud. (Poaceae) and *Exacum walkeri* Griseb. (Gentianaceae) are recorded for the first time from India. Plants recorded for the first time from Kerala are : *Aphyllorchis montana* (Thw.) Reichb. f. (Orchidaceae), *Asplenium affine* Sw. forma *affine* (Aspliniacee) and *Malaxis latifolia* Sm. (Orchidaceae.)

The descriptions of a few plants like *Claoxylon anomalum* Hook f. (Euphorbiaceae), *Eulophia cullenii* (Wight) Blume (Orchidaceae) and *Vanilla wightiana* Lindl. ex Hook. f. (Orchidaceae) which were based on insufficient materials were amended after a thorough study of sufficient materials collected from the area.

Malaxis latifolia Sw. (Orchidaceae) and *Reissantia grahamii* (Wight) Ding Hou (Hippocrateaceae) are new additions to Flora of Presidency of Madras.

Several rare plants could be relocated during the present work. Plants which were collected after a lapse of 50 or more years include: *Actinodaphne campanulata* Hook. f. var. *obtusa* Gamble (Lauraceae), *Ampelocisus arnottiana* (Vitaceae), *Humboldtia unijuga* Bedd. (Caesalpiniaceae), *Memecylon wightianum* Triana (Melastomataceae), *Pogostemon travancoricum* uedd. (Lamiaceae) and *Popowia beddomeana* Hook. f. & Thoms. (Annonaceae). Many plants collected during the present study were either not represented or poorly represented in MH and CAL. *Eulophia cullenii* (Wight) Blume and *Vanilla wightiana* Lindl ex Hook. f. were not represented in MH and CAL. New representations to MH from India include: *Buchanania lanceolata* Wight, *Claoxylon*

anomalum Hook f., *Eragrostis cumingii* Steud., *Exacum walkeri* Griseb. and *Reissantia grahamii* (Wight) Ding Hou.

Several plants described from this district were represented in Herbaria by only their type specimens. Five such plants have been relocated from their type locality for the first time after their type collections. They are: *Actinodaphne campanulata* Hook. f. var. *obtusa* Gamble (Chemungi), *Humboldtia unijuga* Bedd. (below Agastyar Peak), *Morinda reticulata* Gamble (Merchiston), *Pogostemon travancoricum* Bedd. (Attraymallay) and *Vernonia bourdillonii* Gamble (Chemungi).

Endemic Plants : Plants endemic to this district are *Actinodaphne companulata* Hook. f var. *obtusa* Gamble, *Clematis bourdillonii* Dunn, *Cinnamomum travancoricum* Gamble, *Eria muscicola* (Lindl,) Lindl. var. *brevilingius* Joseph & Chandras. and *Ochlandra ebracteata* Raizada & Chatterjee.

The present work has also resulted in the lectotypification of *Clematis bourdillonii* Dunn.

Rare and threatened plants : Based on the present field observations on the relative frequency of distribution of the plants, rarity/restricted distribution of the following is confirmed. Some of these are already listed as threatened (Henry *et al* 1979). *Acanthephippium bicolor* Lindl *Actinodaphne campanulata* Hook.f. var. *obtusa* Gamble, *Aphyllorchis montana* (Thw.) Reichb.f. *Chilochista pusilla* (Willd.) Schlech., *Drypetis malabarica* (Bedd) Airy Shaw, *Dimorphocalyx beddomei* (Benth.) Airy Shaw, *Eria muscicola* (Lindl.) var. *brevilinguis* Joseph & Chandras., *Eulophia cullenii* (Wight) Blume, *Glochidion bourdillonii* Gamble, *G. fagifolium* Miq., *Malaxis latifolia* Sm., *Morinda reticulata* Gamble, *Memecylon angustifolium* Wight, *M. wightianum* Triana, *M. gracile* Bedd., *Paphiopedilum druryii* (Bedd.) Stein. *Pogostemon travancoricum* Bedd., *Premna glaberrima* Wight, *Vanilla wightiana* Lindl. ex Hook.f., *Vernonia bourdillonii* Gamble and *V. ramaswamii* Hutch.

The nomenclature of all the plants has been brought uptodate by strict adherence to the International Code of Botanical Nomenclature (1988). The identity of every plant was checked by 'Type method' and the correct taxonomic status evaluated which have necessitated several new combinations (*vide* Mohanan in J. Econ. Tax. Bot. 6: 480. 1985).

SYSTEMATIC TREATMENT

ARTIFICIAL KEY TO THE FAMILIES

1. Ovules not enclosed in carpels:

2. Perianth present; woody climbers — GNETACEAE

2. Perianth absent; trees or shrubs:

3. Leaves simple — PODOCARPACEAE

3. Leaves pinnate — CYCADACEAE

1. Ovules enclosed in carpels:

4. Leaves mostly reticulately nerved; flowers 4-5 merous; cotyledons 2:

5. Calyx and corolla present:

6. Patals free:

7. Stamens mostaly hypogynous:

8. Sepals imbricate in bud:

9. Sepals free:

10. Stamens more than 12:

11. Sepals 2-3:

12. Aquatic plants — CABOMBACEAE

12. Terrestrial plants — PORTULACACEAE

11. Sepals 4 or more:

13. Plants aquatic:

14. Carpels connate — NYMPHAEACEAE

14. Carpels free — NELUMBONACEAE

13. Plants not aquatic:

15. Sepals not persistent:

16. Carpels free — RANUNCULACEAE

16 Carpels connate:

17. Herbs — CLEOMACEAE

17. Trees or shrubs :

18. Ovary supported by gynophore — CAPPARACEAE

18. Ovary not as above:

19. Anthers horse-shoe shaped; capsules echinate — BIXACEAE

19. Anthers not as above; capsules not echinate — FLACOURTIACEAE

15. Sepals persistent:

20. Leaves alternate:

21. Stamens free from petals:

22. Styles free; disc absent — DILLENIACEAE

22. Styles connate; disc present — OCHNACEAE

21. Stamens adnate to the bases of petals — THEACEAE

20. Leaves opposite or whorled — CLUSIACEAE

10. Stamens 10 or less:

23. Flowers 3-merous:

24. Flowers unisexual — MENISPERMACEAE

24. Flowers bisexual — MAGNOLIACEAE

23. Flowers 4-5- merous

25. Petals 4 — BRASSICACEAE

25. Petals 5:

26. Sepals persistent; ovary 1-loculed :

27. Placentation parietal :

28. Leaves stipulate — VIOLACEAE

28. Leaves exstipulate — PITTOSPORACEAE

27. Placentation free-central — CARYOPHYLLACEAE

26. Sepals not persistent; ovary 2 or more loculed :

29. Filments free :

30. Leaves stipulate — BALSAMINACEAE

30. Leaves exstipulate — SAPINDACEAE

29. Filaments connate :

31. Flowers zygomorphic :

32. Trees — XANTHOPHYLLACEAE

32. Herbs or undershrubs — POLYGALACEAE

31. Flowers actinomorphic :

33. Fruit a capsule — LINACEAE

33. Fruit a drupe or nut — ERYTHROXYLACEAE

9. Sepals more or less united at base :

34. Two sepals enlarge in fruits — DIPTEROCARPACEAE

34. Sepals not as above :

35. Leaves gland-dotted — RUTACEAE

35. Leaves not gland-dotted :

36. Carpels septate :

37. Stamens alternating with petals :

38. Ovules pendulous :

39. Leaves compound (except *Samadera*) :

40. Fleshy herbs — OXALIDACEAE

40. Trees or shrubs :

41. Filaments free — SIMAROUBACEAE
41. Filaments connate into a tube — MELIACEAE

39. Leaves simple:

42. Petals 2-lobed — DICHAPETALACEAE
42. Petals entire — ICACINACEAE

38. Ovules erect:

43. Ovary 3-5-loculed:

44. Stamens 4-5 — CELASTRACEAE
44. Stamens 3:

45. Ovules axile — HIPPOCRATEACEAE
45. Ovules not axile — ERYTHROPALACEAE

43. Ovary mostly 1-loculed (except *Buchanania*) — ANACARDIACEAE

37. Stamens opposite to petals

46. Petals valvate:

47. Leaves exstipulate:

48. Ovary 3-5-loculed:

49. Petioles with 2 auricles — LEEACEAE
49. Petioles without auricles — OLACACEAE

48. Ovary 1-loculed — OPILIACEAE

47. Leaves stipulate — VITACEAE

46. Petals imbricate — SABIACEAE

36. Carpels not septate — ANCISTROCLADACEAE

8. Sepals valvate in bud:

50. Flowers 3-merous — ANNONACEAE
50. Flowers 4-6 merous:

51. Filaments connate :

52. Anthers unilocular :

53. Stamens monadelphous — MALVACEAE

53. Stamens polyadelphous — BOMBACACEAE

52. Anthers bilocular — STERCULIACEAE

51. Filaments free :

54. Leaves compound — BURSERACEAE

54. Leaves simple :

55. Stamens many :

56. Petals ciliate or laciniate — ELAEOCARPACEAE

56. Petals not as above — TILIACEAE

55. Stamens 4-5 — RHAMNACEAE

7. Stamens perigynous or epigynous :

57. Stems not flattened or articulated :

58. Carpels free :

59. Ovules basal or axile :

60. Carpel 1

61. Flowers actinomorphic — MIMOSACEAE

61. Flowers zygomorphic :

62. Upper petal outermost — FABACEAE

62. Upper petal innermost — CAESALPINIACEAE

60. Carpels more than 1 :

63. Flowers bisexual or polygamous :

64. Styles free :

65. Leaves stipulate :

66. Flowers actinomorphic — ROSACEAE

66. Flowers zygomorphic — CHRYSOBALANACEAE

65. Leaves exstipulate :

67. Carpels free; fruit a follicle :

68. Trees or climbing shrubs — CONNARACEAE

68. Fleshy herbs — CRASSULACEAE

67. Carpels united; fruit a capsule :

69. Ovary superior — MOLLUGINACEAE

69. Ovary half inferior — AIZOACEAE

64. Styles united :

70. Calyx lobes imbricate :

71. Petals imbricate in bud :

72. Leaves opposite — MYRTACEAE

72. Leaves alternate — BARRINGTONIACEAE

71. Petals contorted in bud — MELASTOMATACEAE

70. Calyx lobes valvate :

73. Ovary free from calyx :

74. Flowers in panicles — LYTHRACEAE

74. Flowers solitary — SONNERATIACEAE

73. Ovary adnate to calyx-tube — ONAGRACEAE

63. Flowers unisexual :

75. Fruits 2-3-winged — BEGONIACEAE

75. Fruits not winged — CUCURBITACEAE

59. Ovules pendulous :

76 Ovules 2 in each locule :

77. Leaves opposite — RHIZOPHORACEAE

77. Leaves alternate — COMBRETACEAE

76. Ovule 1 in each locule :

78. Flowers in umbels :

79. Herbs — APIACEAE

79. Trees or shrubs; sometimes scandent — ARALIACEAE

78. Flowers not in umbels :

80. Stigmas capitate — ALANGIACEAE

80. Stigmas not capitate — CORNACEAE

58. Carples united :

81. Leaves glandular-hairy — DROSERACEAE

81. Leaves not as above :

82. Climbers with tendrils — PASSIFLORACEAE

82. Erect plants without tendrils — TURNERACEAE

57. Stems flattened and articulated — CACTACEAE

6 Petals united :

83. Ovary inferior :

84. Stamens inserted on corolla :

85. Anthers free :

86. Ovules 2-4 in each locule — SYMPLOCACEAE

86 Ovule 1 in each locule :

87. Leaves opposite — RUBIACEAE

87. Leaves alternate — SPHENOCLEACEAE

85. Anthers connate — ASTERACEAE

84. Stamens free from corolla — LOBELIACEAE

83. Ovary superior :

88. Ovary 1-loculed :

89. Stamens opposite to corolla-lobes :

90. Calyx glandular — PLUMBAGINACEAE

90. Calyx eglandular — MYRSINACEAE

89. Stamens alternating with corolla-lobes — LENTIBULARIACEAE

88. Ovary 2-many loculed :

91. Stamens free from corolla — EBENACEAE

91. Stamens inserted on corolla :

92. Carpels 3 or more — SAPOTACEAE

92. Carpels 2 :

93. Flowers regular :

94. Leaves opposite :

95. Stamens 2 :

96. Fruit a drupe — OLEACEAE

96. Fruit a capsule — NYCTANTHACEAE

95. Stamens 4 or more :

97. Carpels free :

98. Corona present :

99. Filaments free at apex — PERIPLOCACEAE

99. Filaments connate at apex — ASCLEPIADACEAE

98. Corona absent — APOCYNACEAE

97. Carpels united.

100. Ovary 2-loculed :

101. Corolla-lobes contorted — POTALIACEAE

101. Corolla-lobes valvate — STRYCHNACEAE

100. Ovary 1-loculed — GENTIANACEAE

94. Leaves alternate :

102. Floating herbs — MENYANTHACEAE

102. Plants not floating :

103. Ovules more than 4 in each locule :

104. Styles 2-cleft — HYDROPHYLLACEAE

104. Styles not as above — SOLANACEAE

103. Ovules 4 in each locule :

105. Corolla-lobes imbricate or contorted :

106. Styles gynobasic — BORAGINACEAE

106. Styles terminal — EHRETIACEAE

105. Corolla lobes plicate — CONVOLVULACEAE

93. Flowers irregular :

107. Carpels 2-many ovuled :

108. Ovary 1-loculed :

109. Plants leafless, parasitic — OROBANCHACEAE

109. Plants leafy; not parasitie — GESNERIACEAE

108. Ovary 2-loculed :

110. Fruits not opening elastically :

111. Seeds not winged :

112. Ovules many — SCROPHULARIACEAE

112. Ovules 2 :

113. Flowers with glands — MARTYNIACEAE

113. Flowers without glands — PEDALIACEAE

111. Seeds winged — BIGNONIACEAE

110. Fruits opening elastically from the apex :

114. Seeds supported on retinacula — ACANTHACEAE

114. Seeds not supported on retinacula — THUNBERGIACEAE

107. Carpels 1-ovuled :

115. Fruits not lobed :

116. Inflorescence capitate — AVICENNIACEAE

116. Inflorescence spicate — VERBENACEAE

115. Fruits 4-lobed — LAMIACEAE

5. Calyx absent; corolla rarely present :

117. Flowers bisexual :

118. Ovary inferior :

119. Ovary 4-6-loucled — ARISTOLOCHIACEAE

119. Ovary 1-loculed :

120. Plants parasitic on trees; ovule 1 — LORANTHACEAE

120. Plants root parasitic; ovules 2-4 — SANTALACEAE

118. Ovary superior :

121. Plants herbaceous :

122. Parasitic herbs — CASSYTHACEAE

122. Non-parasitic herbs :

123. Terrestrial plants :

124. Leaves exstipulate :

125. Perianth lobes valvate — NYCTAGINACEAE

125. Perianth lobes imbricate :

126. Ovary 1-locular — AMARANTHACEAE

126. Ovary 2-locular — PHYTOLACCACEAE

124. Leaves stipulate — POLYGONACEAE

123. Aquatic plants — TRISTICHACEAE

121. Plants arborescent; sometimes climbing :

127. Leaves silvery beneath — ELAEAGNACEAE
127. Leaves not as above:

128. Perianth lobes valvate — PROTEACEAE
128. Perianth lobes imbricate:

129. Perianth in 2-series — LAURACEAE
129. Perianth in 1-series — THYMELAEACEAE

117. Flowers unisexual:

130. Plants leafy:

131. Leaves exstipulate — MYRISTICACEAE
131. Leaves stipulate:

132. Ovary 1-loculed:

133. Perianth absent:

134. Leaves alternate — PIPERACEAE
134. Leaves opposite — CHLORANTHACEAE

133. Perianth present:

135. Filaments not inflexed in bud: — ULMACEAE
135. Filaments inflexed in bud:

136. Plants with milky sap — MORACEAE
136. Plants without milky sap:

137. Fruit a capsule — DAPHNIPHYLLACEAE
137. Fruit a drupe or achene:

138. Plants with stinging hairs — URTICACEAE
138. Plants without stinging hairs — STILAGINACEAE

132. Ovary 3-many loculed — EUPHORBIACEAE

130. Plants leafless — BALANOPHORACEAE

4. Leaves parallel nerved; flowers 3-merous; cotyledons 1:

139. Perianth present :

140. Both perianth segments corolline :

141. Seeds minute, powdery :

142. Flowers unisexual — HYDROCHARITACEAE

142. Flowers bisexual :

143. Leaves spinous — AGAVACEAE

143. Leaves unarmed :

144. Flowers regular — BURMANNIACEAE

144. Flowers irregular — ORCHIDACEAE

141. Seeds conspicuous :

145. Ovary inferior :

146. Flowers zygomorphic :

147. Stems spirally twisted — COSTACEAE

147. Stems not as above :

148. Outer perianth series free — MARANTACEAE

148. Outer perianth series united — ZINGIBERACEAE

146. Flowers actinomorphic :

149. Ovules 2-seriate — AMARYLLIDACEAE

149. Ovules 1-seriate :

150. Leaves radical :

151. Flowers white; ovule 2 in each locule — HAEMODORACEAE

151. Flowers yellow; ovules many in each locule — HYPOXIDACEAE

150. Leaves cauline — DIOSCOREACEAE

145. Ovary superior :

152. Flowers not in heads :

153. Both perianth series corolline :

154. Aquatic herbs — PONTEDERIACEAE

154. Terrestrial shrubs or herbs :

155. Climbing shrubs — SMILACACEAE

155. Erect herbs — LILIACEAE

153. Outer perianth series calycine :

156 Leaves ending in spiral tendrils — FLAGELLARIACEAE

156. Leaves not as above — COMMELINACEAE

152. Flowers in dense heads — XYRIDACEAE

140. Both perianth segments calycine :

157. Perianth 2-seriate — ARECACEAE

157. Perianth 1-seriate — ALISMATACEAE

139. Perianth absent :

158. Inflorescence of spadices or spikes :

159. Plants terrestrial :

160 Spadix branched — PANDANACEAE

160. Spadix not branched — ARACEAE

159. Plants aquatic :

161. Flowers in spadices — TYPHACEAE

161. Flowers in racemes or spikes — APONOGETONACEAE

158. Inflorescence of spikelets or heads :

162. Flowers in heads — ERIOCAULACEAE

162. Flowers in spikelets :

163. Stems solid; ligule not split — CYPERACEAE

163. Stems hollow; ligule split in front :

164. Shrubs or trees — BAMBUSACEAE

164. Harbs — POACEAE

RANUNCULACEAE Juss.

Climbing shrubs with tendrils; petals present	*Naravelia*
Climbing shrubs without tendrils; petals absent	*Clematis*

Clematis L.

1. Leaflets pubescent beneath	*C. gouriana*
1. Leaflets glabrous beneath:	
2. Leaflets acute and apiculate at apex	*C. bourdillonii*
2. Leaflets acuminate at apex	*C. naravelioides*

Clematis bourdillonii Dunn in Bull Misc. Inform. 181. 1914 & in Gamble, Fl. Pres. Madras 1: 2. 1957 (repr. ed.).

Leaves pinnate or bipinnate; leaflets 4-6 x 0.7-3.5 cm, ovate or lanceolate, entire, reticulate. Flowers *c.* 2 cm in diam, in terminal er axillary panicles; sepals pubescent without, glabrous within; connectives of anthers produced up to 1 mm long.

Rare in evergreen forests of Merchiston. Fl.: Apr.-May.

Note : This rare species, which could not be collected, is not represented in MH.

Dunn *l. c.* mentioned 2 numbers (*Bourdillon* 554, 860) in the protologue but failed to designate one as type or holotype. Both the specimens (syntypes) were examined, and *Bourdillon* 860 University College Herbarium, Thiruvananthapuram is selected as lectotype.

This plant is closely allied to *C. naravelioides* O. Kuntze but can be distinguished by the pubescent sepals and long produced connectives of anthers.

Clematis gouriana Roxb. ex DC. Syst. 1: 139. 1817; Wight, Icon. tt. 993. & 934. 1845; FBI 1: 4; Rao 1; Dunn 2.

Leaves 2-pinnate; leaflets 3.5-9.5 x 1-3 cm, glabrous above, pubescent beneath, distantly dentate, ovate-lanceolate, acuminate at apex, obtuse at base. Flowers yellow in panicles.

Fairly common in evergreen forests of Kallar at lower levels. Fl. : Apr.-May.

Clematis naravelioides O. Kuntze in Verh. Bot. Ver. Brandenb. 26: 119. 1885. *C. hedysarifolia* auct. non DC. 1818; FBI 1: 4; Sant. in Bull. Bot. Surv. India 3: 13. 1961.

Leaves pinnate; leaflets 5-10 x 3-5 cm, glabrous or sparsely hairy. dentate, coriaceous, ovate, acuminate at apex, cuneate at base. Flowers yellowish in panicles.

Rao *l. c.* reported it from Merchiston.

Naravelia Adans. mut. DC. *nom. cons.*

Naravelia zevlanica (L.) DC. Syst. 1: 167. 1817; FBI 1: 7; Rao 2; Dunn 3. *Atragene zeylanica* L. Sp. Pl. 542. 1753.

Leaves trifoliolate; terminal leaflets sometimes transformed into tendrils; leaflets 5.5-13.5 x 3-7 cm, distantly toothed, puberulous above, pubescent beneath. Flowers pale yellow. Achenes feathery, tailed.

Frequent along roads in evergreen and semievergreen forests of Kallar. Roots used in the treatment of common cold. Fl.: Nov.-Feb. Fr. : Mar.-Sept. *'Kuruppakodi'*

DILLENIACAEAE Salisb.

1. Perennial herbs — *Acrotrema*

1. Shrubs and trees:

2. Trees; young leaves pubescent — *Dillenia*

2. Scandent shrubs; young leaves glabrous — *Tetracera*

Acrotrema Jack

Acrotrema arnottianum Wight, Ill. 1: 9. t. 3. 1840; Majumdar Fasc. Fl. Ind. 2. 2. 1979; FBI 1: 32; Dunn 5.

Herbs with woody rhizomes; stems mostly short, rarely elongated. Leaves 8-26 x 4-12 cm, ovate-oblong, hirsute, denticulate and ciliate along margins, obtuse at apex, cordate at base. Flowers in bracteolate axillary racemes of variable length.

Abundant in road cuttings in moist deciduous forests of Kottur Reserve and evergreen forests of Chemungi. Fl. & Fr.: Apr.-Nov. *'Nilumpunua'*

Note: Two types of plants are met with: one with an elongated stem up to 13 cm long and the other without or with a very short stem.

Dillenia L.

Dillenia pentagyna Roxb. Pl. Cor. 1: 21. t. 20. 1795; FBI 1: 38; Bourd. 1; Dunn 6; Hoogland in Steenis, Fl. Malesiana Ser. 1. 4: 172. 1951 & in Blumea 7: 117. 1952; Majumdar, Fasc. Fl. Ind. 2: 7. 1979.

Spreading trees up to 15 m tall; bark grey; young branches scarred. Leaves 15-35 x 8-15 cm (young ones much larger), oblong-lanceolate, obtuse or subobtuse at apex, acute at base. Flowers yellow, fascicled at nodes of old branches.

Common in grasslands and open forests on the way to Agastyarkudum. Wood valuable for match boxes and splints, locally used as house posts and fire wood. Fl.: Jan.-Mar. Fr.: May-Jun. *'Kodapunna', 'Valapunna' 'Pattipunna'*

Tetracera L.

Tetracera akara (Burm. f.) Merr. Philip. J. Sci. 19: 366. 1921; Hoogland in Steenis, Fl. Malesiana Ser. 1. 4: 146. 1951; Majumdar, Fasc. Fl. Ind. 2: 10. 1979. *Calophyllum akara* Burm. f. Fl. Ind. 121. 1768. *Tetracera laevis* auct. non Vahl 1794; FBI 1: 31; Dunn 5. *T. rheedii* DC. Syst. 1: 402. 1817; Wight, Icon. t. 70. 1838.

Leaves 5-12 x 2.5-4 cm, oblong-lanceolate, entire, acuminate at apex, rounded at base. Flowers 4-merous in terminal panicles; sepals broad, ovate, glabrous without, silky within, persistent; petals white, oblong.

Occasional in open forests at low elevations. Stem used for making baskets. Fl. & Fr.: Sept.-Mar. *'Nennelvalli' 'Akarapatsjoti'*.

Note : In the earlier Indian Floras, this plant was misidentified as *Tetracera laevis* Vahl which is conspecific with *T. indica* (Christm. & Panz.) Merr. Hoogland *l. c.* has shown that this peninsular Indian plant is onlv *T. akara* (Burm. f.) Merr. which can be easily distinguished by its greater smoothness, narrower, entire and acuminate leaves and the sepals silky pubescent within.

Kostermans 2607 collected from Ponmudi and deposited at CAL, as *T. indica* (Christim. & Panz.) Merr. is only *T. akara* (Burm. f.) Merr.

MAGNOLIACEAE Juss.

Michelia L.

Michelia champaca L. Sp. Pl. 536. 1753; FBI 1: 42; Bourd. 2; Rao 3; Dunn 6.

Trees 10-15 m tall. Leaves 10-30 x 4-10 cm, sparsely pubescent, broadly oblong, acuminate at apex, cuneate at base. Flowers yellow, axillary, solitary.

Commonly cultivated in public and house gardens. Fl.: Jul.-Mar.

ANNONACEAE Juss.

1. Flowers on recurved peduncles — *Artabotrys*
1. Flowers not as apove :
    2. Sepals connate at base :
        3. Trees — *Cyathocalyx*
        3. Scandent shrubs — *Uvaria*
    2. Sepals free :
        4. Bracts scaly, distichous on peduncles — *Goniothalamus*
        4. Bracts not as above :
            5. Outer petals sepaloid :